depending on the frequency and magnitude of the secondary resonance, can cause some error if the estimation is using a 2^{nd} order model.

[0258] Sources of Avs Measurement Error—Electrical Component Failure

[0259] In general, failure an electrical component will result in no signal or in increased harmonic distortion. In either case the fault would be detected by AVS integrity checks and the measurement invalidated.

[0260] The one exception that has been identified is a failure of the oscillator used to control the DAC and ADC. If this oscillator were to drift out of tolerance it would introduce a measurement error that would not be detected by the low-level integrity check (it would be detected in an extreme case by the volume integrity checks described above). To guard against these failures, in some embodiments, the oscillator is checked against an independent clock whenever an AVS measurement is initiated.

What is claimed is:

1. A pump, comprising:

a reservoir configured to deliver a fluid;

a port coupled to the reservoir and configured to discharge the fluid;

a plunger having a piston coupled to a shaft, wherein the piston is disposed within the reservoir in sliding engagement with an inner surface of the reservoir, wherein the piston defines a first side of the reservoir and a second side of the reservoir whereby movement of the plunger towards the first side of the reservoir discharges fluid through the port; and

a reference-volume assembly coupled to the reservoir, wherein the reference-volume assembly comprises:

a reference-volume chamber in acoustic communication with the second side of the reservoir;

a speaker disposed within the reference-volume chamber; and

a reference microphone disposed within the reference-volume chamber,

wherein the reference-volume assembly further comprises a conduit configured to receive the shaft, wherein the shaft is in sliding engagement with the conduit.

2. The pump according to claim **1**, wherein the reference-volume assembly is coupled to the reservoir at an opposite end of the reservoir relative to the port.

3. The pump according to claim **2**, further comprising a variable-volume microphone disposed within the reservoir configured to sense a sound wave within the reservoir, the sound wave originating from the speaker.

4. The pump according to claim **1**, further comprising:

an additional reservoir configured to deliver an additional fluid;

an additional port coupled to the additional reservoir and configured to discharge the additional fluid; and

an additional plunger having an additional piston coupled to an additional shaft, wherein the additional piston is disposed within the additional reservoir in sliding engagement with an inner surface of the additional reservoir, wherein the additional piston defines a first side of the additional reservoir and a second side of the additional reservoir whereby movement of the additional plunger towards the first side of the additional reservoir discharges fluid through the additional port; wherein the reference-volume assembly is further coupled to the additional reservoir at an opposite end of the additional reservoir relative to the additional port, wherein the reference-volume chamber is further in acoustic communication with the second side of the additional reservoir.

5. The pump according to claim **4**, wherein at least one of the first and second reservoirs are attachable to the reference-volume assembly.

6. The pump according to claim **5**, further comprising a manifold, the manifold comprising:

a first connector port coupled to the port;

a second connector port coupled to the additional port; a discharge port; and

a fluid path fluidly connecting together the first and second connector ports to the discharge port.

7. The pump according to claim **6**, wherein the manifold is attachable to the first and second connector ports.

8. The pump according to claim **4**, further comprising a variable-volume microphone disposed within the reservoir configured to sense a sound wave within the reservoir.

9. The pump according to claim **8**, further comprising an additional variable-volume microphone disposed within the additional reservoir configured to sense the sound wave within the additional reservoir.

10. The pump according to claim **4**, further comprising a variable-volume microphone disposed on the reference-volume assembly configured to sense a sound wave within the reservoir.

11. The pump according to claim **10**, further comprising an additional variable-volume microphone disposed on the reference-volume assembly configured to sense the sound wave within the additional reservoir.

12. The pump according to claim **1**, further comprising: a linear position sensor configured to sense a position of the shaft.

13. The pump according to claim **1**, further comprising a housing, wherein the reservoir is disposed within the housing; and wherein the plunger is disposed within the housing.

14. The pump according to claim **1**, further comprising an actuator coupled to the shaft to actuate the plunger.

15. The pump according to claim **14**, further comprising a housing, wherein the actuator is disposed within the housing.

16. The pump according to claim **12**, further comprising a housing, wherein the linear position sensor is disposed within the housing.

17. The pump according to claim **1**, wherein the piston comprises a seal disposed along a periphery of the piston.

18. The pump according to claim **1**, wherein the plunger is moveable between a fully discharged position and a fully loaded position, wherein the reference-volume chamber is in fluid communication with the second side of the reservoir when the plunger is positioned anywhere between the fully discharged position and the fully loaded position.